Federal Communications Commission
Washington, D.C. 20554

March 9, 2012

Ms. Marlene Dortch
Secretary
Federal Communications Commission
445 12th Street, SW
Washington, DC 20554

Re: Connect America Fund, WC Docket No.10-90; A National Broadband Plan for our Future, GN Docket No. 09-51; Establishing Just and Reasonable Rates for Local Exchange Carriers, WC Docket No. 07-135; High-Cost Universal Service Support, WC Docket No. 05-337; Developing a Unified Intercarrier Compensation Regime, CC Docket No. 01-92; Federal-State Joint Board on Universal Service, CC Docket No. 96-45; Lifeline and Link-Up, WC Docket No. 03-109

Dear Ms. Dortch:

On November 18, 2011, the Federal Communications Commission (Commission) released the *USF/ICC Transformation Order*.[1] In the *USF/ICC Transformation Order*, the Commission adopted several reforms to increase fiscal responsibility in the universal service program, expand funding opportunities for voice and broadband networks, and incent greater operational efficiency among universal service recipients over time. One such reform was the adoption of a rule to limit reimbursable capital and operations expenses for purposes of determining high-cost loop support (HCLS) to incumbent rate-of-return local exchange carriers.[2] Specifically, the Commission concluded that it would use regression analyses to "place limits on the HCLS provided to carriers whose costs are significantly higher than other companies that are similarly situated and support will be redistributed to those carriers whose unseparated loop cost is not limited by operation of the benchmark methodology."[3]

In the Further Notice of Proposed Rulemaking (FNPRM) accompanying the *USF/ICC Transformation Order*, the Commission sought comment on a specific proposed methodology for setting benchmark levels to estimate appropriate levels of capital expenses and operating

[1] *Connect America Fund; A National Broadband Plan for Our Future; Establishing Just and Reasonable Rates for Local Exchange Carriers; High-Cost Universal Service Support; Developing a Unified Intercarrier Compensation Regime; Federal-State Joint Board on Universal Service; Lifeline and Link-Up; Universal Service Reform—Mobility Fund*; WC Docket Nos. 10-90, 07-135, 05-337, 03-109, CC Docket Nos. 01-92, 96-45, GC Docket No. 09-51, WT Docket No. 10-208, Report and Order and Further Notice of Proposed Rulemaking, FCC 11-161 (rel. Nov. 18, 2011) (*USF/ICC Transformation Order*); *pets. for review pending sub nom. Direct Commc'ns Cedar Valley, LLC v. FCC*, No. 11-9581 (10th Cir. filed Dec. 8, 2011) (and consolidated cases).

[2] *Id.* at para. 196.

[3] *Id*. at para. 220.

expenses for each incumbent rate-of-return study area, using publicly available data.[4] The Commission sought comment on using the methodology to impose limits on reimbursement from HCLS.

The Wireline Competition Bureau (Bureau) is currently considering the record received on this topic in response to the FNPRM and through the *ex parte* process. In addition, consistent with Office of Management and Budget (OMB) guidelines,[5] the Bureau recently sought peer review of the methodology proposed in Appendix H of the FNPRM.[6] In this letter, the Bureau provides copies of the peer review charge letter and the peer review submissions that were provided to the Bureau on March 2, 2012.[7]

In response to the record and peer reviews, and in addition to sources already provided in Appendix H, the Bureau is considering the use of the following data sets in the regression:

- U.S. Department of Agriculture, Natural Resources Conservation Service, Available Soil Survey Data (SSURGO) (2012), last visited Dec. 19, 2011, *available at* http://soildatamart.nrcs.usda.gov/StatusMaps/SoilDataAvailabilityMap.pdf (for soil types)
- U.S. Department of Agriculture, Natural Resources Conservation Service, U.S. General Soil Map (STATSGO2), last visited Dec. 19, 2011, *available at* http://soils.usda.gov/survey/geography/statsgo (for soil types)
- U.S. Department of Agriculture, U.S. National Arboretum, Plant Hardiness Zone Map (2012), last visited Feb. 2, 2012, *available at* http://www.usna.usda.gov/Hardzone (for climate information)
- U.S. Department of Commerce, U.S. Census Bureau, TigerLine® Shape Files (2009), last visited Oct. 5, 2011, *available at* http://www2.census.gov/cgi-bin/shapefiles2009/national-files (for road information)
- U.S. Department of Commerce, U.S. Census Bureau, TigerLine® Shape Files, (2010), last visited Oct. 5, 2011, *available at* http://www.census.gov/cgi-bin/geo/shapefiles2010/main (for road information)
- U.S. Department of the Interior, U.S. Fish and Wildlife Service, National Wetlands Inventory, last visited Feb. 2, 2012, *available at* http://107.20.228.18/Wetlands/WetlandsMapper.html# (for climate information)
- U.S. Department of the Interior, U.S. Geological Survey, Digital Elevation Model Information, last visited Feb. 9, 2012, *available at* http://rmmcweb.cr.usgs.gov/elevation/dpi_dem.html (for topology information)

[4] *See Id*. at paras. 1079-88. Comments and reply comments to the FNPRM were due on Jan. 18, 2012 and Feb. 17, 2012.

[5] *OMB Final Information Quality Bulletin for Peer Review*, 70 Fed. Reg. 2664 (Jan. 14, 2005) (OMB Bulletin) (requiring that influential scientific information on which a federal agency relies in a rule-making proceeding be subject to peer review to enhance the quality and credibility of the government's scientific information).

[6] *See* appendix A.

[7] *See* appendices B and C.

- U.S. Department of the Interior, U.S. Geological Survey, National Hydrography Dataset, last visited Feb. 1, 2012, *available at* http://nhd.usgs.gov/index.html (for information about water levels)
- U.S. Department of Transportation, Research and Innovative Technology Administration (RITA), Bureau of Transportation Statistics (BTS), National Transportation Atlas Database (2011), last visited Jan. 31, 2012, *available at* http://www.bts.gov/publications/national_transportation_atlas_database/2011 (for road information)
- South Slope Cooperative Telephone Company, Amana Colonies Telephone Company D/B/A HickoryTech, and Heartland Telecommunications Company of Iowa Joint Petition for Expedited Study Area Waiver, CC Docket No. 96-45 (filed Dec. 13, 2000) (for study area information).
- North Dakota Public Service Commission Order Granting Polar Telecommunications, Inc.'s Application for Expansion of Eligible Telecommunications Carrier (ETC) Designated Geographical Service Area, September 24, 2008, *available at* http://www.psc.nd.gov/database/documents/08-0213/009-020.pdf (for study area information)
- Montana Independent Telecommunications Carriers, Advanced Services/Facilities Map (see Appendix D) (for study area information)
- ESRI ArcGIS Bing Maps Road, last visited Feb. 7, 2012, *available at* http://www.arcgis.com/home/item.html?id=b28fe82cf6cd4efca92a30a10b95a461 (for road information)
- ESRI ArcGIS StreetMap, last visited Feb. 7, 2012, *available at* http://gislab.allegheny.edu/Documents/StreeMap_USA.pdf (for road information)
- GDT, Wire Center Premium (April 2001) (for study area information)
- Tele Atlas, Wire Center Premium v11.2 (July 2007) (for study area information)
- TomTom, Telecommunications Suite 2011.09 (for study area information)

As always, we welcome the input of interested parties on the peer review submissions, on the data sources listed above, and any other matters related to the implementation of the proposed methodology for setting appropriate HCLS benchmark levels.

Sincerely,

Patrick Halley
Legal Counsel
Wireline Competition Bureau

APPENDIX A

DATE: February 21, 2012

TO: Tracy Waldon, Media Bureau
Paroma Sanyal, Office of Strategic Planning and Policy Analysis

FROM: Sharon E. Gillett, Chief, Wireline Competition Bureau

SUBJECT: Peer Review of a Regression Analysis of Rate-of-Return Carrier Costs

In this memorandum, the Wireline Competition Bureau requests that you conduct a peer review of a regression analysis of rate-of-return carrier costs.

In the *USF/ICC Transformation Order*, the Commission concluded that it would use regression analyses to limit high-cost loop support (HCLS) payments to rate-of-return carriers with very high capital and/or operating expenses relative to their similarly situated peers, in order to increase fiscal responsibility in the universal service program, expand funding opportunities for voice and broadband networks to more carriers, and incent greater operational efficiency among carriers over time.[1] The Commission sought comment on a specific methodology for the regressions, and directed the Bureau to adopt a final methodology.

The Wireline Competition Bureau is currently considering the best means to implement these regressions. To assist in the effort, and consistent with Office of Management and Budget (OMB) guidelines,[2] we seek peer review of Appendix H of the *USF/ICC Transformation Order and Further Notice of Proposed Rulemaking*, which sets out a proposed methodology for public comment.[3] The appendix begins at page 622 and is 10 pages long including two pages of tables.

The methodology set forth in Appendix H estimates the cost of the lowest cost carrier in the highest cost decile (i.e., the 90th percentile of cost) among similarly situated carriers (i.e.,

[1] *Connect America Fund; A National Broadband Plan for Our Future; Establishing Just and Reasonable Rates for Local Exchange Carriers; High-Cost Universal Service Support; Developing a Unified Intercarrier Compensation Regime; Federal-State Joint Board on Universal Service; Lifeline and Link-Up; Universal Service Reform—Mobility Fund*; WC Docket Nos. 10-90, 07-135, 05-337, 03-109, CC Docket Nos. 01-92, 96-45, GC Docket No. 09-51, WT Docket No. 10-208, Report and Order and Further Notice of Proposed Rulemaking, FCC 11-161 (rel. Nov. 18, 2011) (*USF/ICC Transformation Order*); *pets. for review pending sub nom. Direct Commc'ns Cedar Valley, LLC v. FCC*, No. 11-9581 (10th Cir. filed Dec. 8, 2011) (and consolidated cases).

[2] *OMB Final Information Quality Bulletin for Peer Review*, 70 Fed. Reg. 2664 (Jan. 14, 2005) (OMB Bulletin) (requiring that influential scientific information on which a federal agency relies in a rule-making proceeding be subject to peer review to enhance the quality and credibility of the government's scientific information).

[3] Available at http://transition.fcc.gov/Daily_Releases/Daily_Business/2012/db0206/FCC-11-161A1.pdf.

accounting for all the variation driven by the independent variables of the analysis), which is then used to calculate HCLS.

Today, carriers submit accounting cost data to the National Exchange Carrier Association which calculates an average cost per loop for each individual company, which in turn determines eligibility for universal service HCLS. As set forth by the Commission, the objective of the regression methodology is to "limit high-cost loop support amounts for rate-of-return carriers to reasonable amounts relative to other carriers with similar characteristics."[4]

Consistent with OMB peer review guidelines, you should evaluate whether the econometric and economic analyses are reasonable and technically correct, and consistent with accepted practices in the field. You should identify any scientific uncertainties and explain the potential implications of the uncertainties for the technical conclusions drawn, and provide suggestions, if any, for ways to minimize key uncertainties and how the methodology might be improved. The bureau will deliver printed copies of comments in response to the FNPRM addressing the technical aspects of the Appendix.

You may access the data and code used by WCB staff in developing Appendix H, which will allow you to replicate the analysis, at the following URL:
http://fcc.gov/wcb/CAF.ZIP
The zip file has the STATA .do file and the data in both Excel and Stata format. Additional notes on this data set are provided in the attachment.

Consistent with the requirements of the OMB guidelines, we are not asking you to "provide advice on policy" or to evaluate the policy implications of the study.[5] In particular, in developing the methodology in Appendix H, a number of policy decisions were made that you should consider beyond this charge unless you have reason to believe these decisions render the analysis technically flawed. These decisions include:

- Staff used calculations from the NECA algorithm as dependent variables in the regression equation rather than other measures of cost. This approach ensures that any cap can be easily incorporated into the support calculation for each carrier.
- Staff defined "outliers" (those whose funding will be affected, not necessarily outliers in a statistical sense) as those with costs in excess of the 90th percentile. Some comments in response to the FNPRM suggested that other thresholds be adopted; these comments are under consideration.

[4] *USF/ICC* Transformation *Order*, FCC 11-161, at para. 216.

[5] The OMB Bulletin states in relevant part: "Peer reviewers can make an important contribution by distinguishing scientific facts from professional judgments. Furthermore, where appropriate, reviewers should be asked to provide advice on the reasonableness of judgments made from the scientific evidence. However, the charge should make clear that the reviewers are not to provide advice on the policy…." OMB Bulletin, 70 Fed. Reg. at 2669.

The identity of the reviewers will be public. This request and your response will also be placed in the public record of the pending FNPRM. Past peer reviews can be found at http://www.fcc.gov/encyclopedia/peer-review-agenda.

We ask that you provide an individual written report of your review, findings, and recommendations by February 28, 2012.

Please feel free to reach out to Steve Rosenberg, Rodger Woock, Craig Stroup or James Eisner if you have any questions about the material under review, and to Carol Mattey or Amy Bender, if you have any general questions about the policy issues under consideration in this proceeding.

Thank you very much for your assistance in this matter.

ATTACHMENT

Additional notes on the data set used in the regression analysis:

You will notice in this data set that the Census data for one carrier (Allband) are erroneously all zeros. Staff will be correcting that problem before finalizing the study. In addition, staff expects to add five observations to the posted data set before finalizing the methodology. Three of these observations are from study areas that were mistakenly excluded from the analysis described in Appendix H. The two additional observations are from study areas in American Samoa and Guam. In these instances, we expect the final methodology will use pre-2010 Census data because the Census Bureau has not yet published the 2010 data for all the territories. Staff also expects to exclude from the data set those areas within about 25 cost companies that have frozen support due to operation of section 54.305 of the Commission's rules, which provides that carriers acquiring exchanges receive support for the acquired exchanges at the same per-loop support as calculated at the time of transfer. *See* 47 C.F.R. § 54.305.

APPENDIX B

TO: Sharon E. Gillett, Chief,
Wireline Competition Bureau, Federal Communications Commission

FROM: Paroma Sanyal
Economist, OSP

RE: Peer Review of WCB's "Modeling Limits on Reimbursable Operating and capital Costs" (Appendix H) of "Establishing Just and Reasonable Rates for Local Exchange Carriers". WC Docket No. 07-135.

DATE: March 2, 2012

The econometric model specified in Appendix H of the *USF/ICC Transformation Order and Further Notice of Proposed Rulemaking* outlines a regression based procedure that helps identify rate-of-return carriers whose costs are significantly higher relative to comparable peers. Once identified, such carriers would then have limits placed on their High Cost Loop Support (HCLS) payments, i.e. the carriers identified as high-cost would not be able to recover the full incurred costs. Currently HCLS payments are determined based on comparing the cost per-loop of a study area with the national average. The justification for implementing caps is to reduce costs and improve efficiency of the rate-of-return carriers. The proposed methodology outlines a systematic way of identifying carriers that may be considered less efficient (higher cost) than their peers, and limiting their payments, to incentivize cost-minimization behavior and efficiency improvements.

A quantile regression methodology is used to compute the payment caps. Since the goal of the exercise is to identify very high cost carriers, the quantile regression methodology provides a simple method of estimating the upper bound of a data scatter plot, controlling for various explanatory variables. The model estimates the relationship between a specified conditional quantile (in this case, the 90^{th} percentile) of a dependent variable (capital and operating expenditures) and the explanatory variables (geographic and demographic attributes). In this particular case, using quantile regressions is an improvement over OLS, as it allows slope coefficients to vary over percentiles, is robust to outliers and heteroscedastic errors. However, although well-suited to the problem at hand, there are some issues which when addressed, will make a more compelling case for using this methodology to identify high-cost carriers, set cost limits, and spur efficiency. I discuss these in order of importance.

1. One major concern with the proposed specification is the underlying assumptions behind the model. By disaggregating the total cost function, and estimating the cost lines separately using quantile regression, and then adding them up, assumes that the quantile of the sums equals the sum of the quantiles. An argument that is similar to the sum of means of a random variable being equal to the mean of the sum. However, this relationship does not hold true for quantile regressions. This implies that capping the individual cost components at the 90^{th}

percentile does not guarantee that the total cost will be capped below the 90th percentile. Thus applying the quantile regression to the individual cost components may miss some high cost carriers, or mislabel others as high cost. In his comments (Appendix E) on behalf of the National Exchange Carrier Association; Inc. and other parties (WC Docket No. 10-90 et. al.), Prof. Roger Koenker has an illustrative example of this.

2. A related point is how this individual cost capping mechanism affects efficiency. The idea behind capping reimbursements is to incentivize carriers to reduce their costs. However, individual cost capping ignores any complementary or substitutability between the various cost components. This may discourage a company from overall cost-minimization if that means that after minimization, one of the cost categories will fall above the 90th percentile threshold, even though the total costs are lower. Additionally, each carrier may have different tradeoffs amongst its cost components, and the current methodology is akin to a one-size fits all approach. A more flexible approach may be to estimate the 90th percentile over the total costs. This would be more in line with theoretical cost-minimization approaches where price caps or expenditure caps can enhance efficiency under a rate-of-return regulation. Alternatively, some flavor of a stochastic frontier analysis could be performed to identify the high-cost carriers.

3. Another related issue is the choice of which cost components to cap. There was little discussion in the paper about why some costs were chosen to be capped, while others were not. This creates some ambiguity in how to interpret the results.

4. The specifications may suffer from omitted variable bias, as several important factors that may explain loop cost have not been included in the regression. For example, percentage of bedrock in the construction area, soil type, the presence of roads and streams can all lead to higher loop construction costs. For example, an area a higher percentage of bedrock that is difficult to drill through, or one with rocky or dense soil may historically have higher construction costs. Additionally, if there are roads or streams that intersect an area, construction costs may be higher. Other variables such as the amount of rainfall and the number of frost-free days may also influence the cost of loop construction. A majority of this GIS data can possibly be obtained from public sources such as the Soil Survey Geographic Database from Natural Resource Conservation Service. The Nebraska Rural Independent Companies' Capital Expenditure Study[1] makes a fairly compelling case for including these variables in the regression analysis. Comments filed by the National Association of State Utility Consumer Advocates, Maine Office of the Public Advocate, The New Jersey Division of Rate Counsel, and The Utility Reform Network has a detailed discussion on this that explains why the FCC should have used the geographic data even though the coverage is not extensive (WC Docket No. 07-135, pp.46). Similar conclusions are also discussed by the "Comments of the Nebraska Rural Independent Companies" (WC Docket No. 07-135).

[1] http://www.bbpmag.com/docs2011/vantage%20Point%20model%20background.pdf

5. In the regressions, the number of loops is the most significant predictor of costs. However, one may think about using an alternative variable, such as the loop length, which may be a better predictor of costs than simple loop counts. One could argue that there could be cases where carriers in very rural and sparsely populated areas are forced to build longer loops to serve customers, as opposed to carriers who serve relatively denser areas. Arguably, the cost of the one long loop will be greater than the cost of a short loop, and thus using the number of loops as a covariate distorts the cost predictions on the long-loop carrier. If there are compelling reasons not to use the loop length, it should be stated in the discussion. Otherwise alternative specifications should be discussed. In addition, as pointed out by the comments submitted by Moss Adams LLP. et. al. (WC Docket No. 07-135, pp. 11) "subscribers per mile of loop plant" may be a more appropriate in explaining loop costs.

6. The regressions are implemented as a log-log framework. A justification for adopting this specification needs to be added. For instance, what is it about the data that precludes the use of a linear or a log-linear specification? How do results change if you implement the alternative specifications? What is the fit of these alternative specifications? This issue has been partly discussed by the "Comments of the Nebraska Rural Independent Companies" (WC Docket No. 07-135, pp. 42).

7. A related point, is the treatment of zeros values when taking logs of the dependent and independent variables. A large number of explanatory variables have a significant portion of zero values (92% of the landarea_ua, housing_ua and blocks_ua variables have zero values, and approximately 74 percent of the landarea_uc, housing_uc and blocks_uc have zero values). When taking logs, 1 is added the zero values. Thus, in light of the large number of zeros, there is a question of how sensitive the regression estimates are to adding 1 versus 0.5 or 2. A solution may be to treat these variables differently, rather than taking logs. This is a point that Prof. Roger Koenker makes in Appendix E (pp.8) as part of the comments submitted by the National Exchange Carrier Association; Inc. and other parties (WC Docket No. 10-90 et. al.).

8. Studying the regression results, one is puzzled by the fact that in some regressions, the loop costs are higher for the housing units in urban areas than rural areas. I suspect that the housing variable may be proxying for some omitted variables, or that the high percentage of zeros in this variable (92%) may be leading to the counterintuitive result.

9. A table providing a detailed description of all the independent and dependent variables along with the abbreviations used in the tables would help in making the discussion and interpretation of results much clearer.

10. Providing the summary statistics for the dependent and independent variables would be very helpful. For instance, without the summary statistics, it is difficult to figure out what percentage of the dependent variable are zeros. If it is a large percentage, then a censored quantile regression methodology would be more appropriate. However, as it turns out, there is less than 5% zeroes in the dependent variables, and thus the current methodology is appropriate. This should be made clear in the write-up.

11. The analysis shows the results for the 90th percentile. It would be interesting to compare the results with regression of other percentiles, and observe whether the effects of the explanatory variables are the same across percentiles. For instance one could perform a simultaneous-quantile regression and estimate all the effects simultaneously. Or a median regression could be estimated, so that it could serve as a baseline comparison model.

12. Table 2 includes the weighted density variable and not Table 1 (Appendix H, para. 29).

APPENDIX C

DATE: March 2, 2012

TO: Sharon E. Gillett, Chief, Wireline Competition Bureau

FROM: Tracy Waldon, Chief Economist, Media Bureau

SUBJECT: Formal Peer Review of Appendix H of the *USF/ICC Transformation Order and Further Notice of Proposed Rulemaking*

In response to your request, I have reviewed the econometric and economic analyses contained in Appendix H of the *USF/ICC Transformation Order and Further Notice of Proposed Rulemaking*, as well as the supporting data and code made available to me. In keeping with the peer review charge, I have refrained from reviewing the decision to examine individual NECA algorithm steps as well as the choice of the 90th quantile as a cutoff. My overall opinion is that the method rests on a sound theoretical footing, though it is in need of additional analysis of specific implementation issues.

The goal of Appendix H is to determine the level of costs such that 90% of similar rate-of-return study areas have costs below this level. This level, the 90th percentile, is estimated for twelve different cost categories that go into determining the amount of high cost loop support (HCLS) payments to rate-of-return carriers. The method employed to determine the 90th percentile is quantile regression. This allows the estimation of the 90th conditional quantile function for each cost category and thereby allowing comparisons of study areas with different observable cost structures as if they were similarly situated. The estimated coefficients are then used to predict the 90th quantile of each cost category based on the observable characteristics of a particular study area. If the costs of the study area in a category exceed the predicted 90th quantile, then the study area will not be fully reimbursed for its costs in that category.

My review of the Appendix focuses on four areas: 1) the quantile regression method, 2) the explanatory variables in the conditional quantile function, 3) the form of the conditional quantile function, and 4) replication.

<u>The Quantile Regression Method.</u> The basic quantile regression method employed by the Appendix has been in use for several decades and has become a standard offering in statistical packages. Like any tool, the empirical method must be chosen for the problem at hand. As stated, the goal is to identify study areas whose costs in a particular category are above a cutoff level based on the expected distribution of those costs among similar study areas. Quantile regression directly estimates this relationship. The appendix briefly discusses the use of ordinary least squares for this problem and suggests several reasons why quantile regression is preferred to least squares. The reasoning presented in the Appendix is unconvincing. For example, the concerns regarding heteroskedasticity and non-normal errors are exaggerated because ordinary

least squares will provide consistent estimates of the linear conditional expectation function, though not the standard errors, in those situations.[1]

Regardless of the stated reasoning, in my opinion, quantile regression is the appropriate tool for the estimation problem at hand. Quantile regression directly estimates the conditional quantile function and therefore requires no additional assumptions in regards to the underlying distribution of the data. Use of least squares would consistently estimate the conditional expectation function. However that is not the item of interest. Further assumptions in regards to the underlying distribution of the data would be required in order to estimate the 90^{th} quantile of the cost distribution. Failure of any of these assumptions would bias the estimates of the 90^{th} quantile derived from least squares. Therefore, direct estimation via quantile regression is the preferred method.

Explanatory Variables. Because the goal of the Appendix is to predict the 90^{th} quantile of similarly situated study areas, careful consideration must be placed on the explanatory variables that will determine whether study areas are similarly situated. The Appendix does a reasonable job of selecting explanatory variables that are likely to be common across all of the cost categories. These variables are generally related to population density and service territory and the same set of variables is used for each of twelve cost categories. However, in its current form, the Appendix does not make a convincing argument that the existing explanatory variables are sufficient to adequately determine similarly situated study areas. A more convincing presentation would begin with a detailed discussion of each of the cost categories and the factors which are likely to drive those costs. In this manner, the conditional quantile function for each cost category would be customized to the relevant cost drivers. For example, cost categories for operating expenses may be heavily influenced by the prevailing wage, while the cost categories for capital expenditures may not be influenced by labor expenses at all.

I would recommend giving careful consideration to the methods used to select the explanatory variables. Of particular importance may be distinguishing between the statistical significance of a variable and its economic significance. Statistical significance will provide information on how precisely the coefficient was estimated, however it can easily be the case that a vey precisely estimated cost driver may only account for a fraction of a percent of the cost variation across study areas. A different cost driver may be imprecisely measured to such an extent that one cannot reject the hypothesis that the true value is zero. However, the magnitude of the estimated coefficient may indicate that the cost driver is of economic significance because a substantial portion of the conditional quantile is derived from it. While there are a number of ad-hoc algorithms such as step-wise regression for deciding on a set of explanatory variables, the present problem may be best served by prior knowledge. The process by which firms produce telecom services is fairly well-known. Existing knowledge about that production process from engineering models and studies may provide the best guidance in regards to which factors are the most significant cost drivers.

[1] See for example section 4.2.1 in Wooldridge (2001) and sections 2.3 and 2.9 in Hayashi (2000).

Functional Form. The Appendix proposes that the correct functional form for the conditional quantile function is double log. In this form, the natural log of both the dependent and independent variables is used in the linear conditional quantile function. The Appendix reports that this transformation is used to "linearize" the relationship though it does not provide any evidence that this is the appropriate transformation to generate a linear relationship. The log transformation in the dependent variable is common for dependent variables that only take on positive values. Transformation of the independent variables is less common, though occasionally done because of its convenience in estimating elasticities. However, with the present set of data, the Appendix indicates that a problem was encountered when transforming the data. For a few of the observations of the dependent variables, and a significant number of observations on some of the independent variables, were non-positive leading to the transformation being undefined. To correct for this problem, the Appendix added an offset to all of the transformed variables in order to ensure most of them were positive. The chosen offset was 1. This is simply an arbitrary value; any value greater than zero would have allowed the transformation to proceed. Unfortunately, the value of the offset can have real consequences on the estimated conditional quantile function. I would strongly recommend, at a minimum, that the effect of this choice be carefully examined in order to determine its effect. Preferably, a serious reconsideration of the double log form should be done. While transforming the dependent variable falls within accepted empirical practices, the transformation of explanatory variables where half or more of the values are zero, does not. In my mind, observing a significant number of zero-valued independent variables and only a few zero-valued dependent variables is a clear indicator that the double log form is inappropriate. If there is concern in regards to non-linear marginal effects of the independent variables, I would suggest investigating the use of polynomials or splines to account for this non-linearity, rather than a log transformation.

Replication. I have been able to replicate the tables presented in Appendix H using the data and code available on the FCC website. I would note two items in regards to replication. The estimation was performed using Stata. A recent update to Stata has changed the default methods used to estimate the standard errors. This makes replication slightly more complicated. The second item I note is an error in the code. Line 79 of the file qregWEB.do retransforms the predicted 90^{th} quantile from the log value to the untransformed value of the cost category. It fails to subtract the value of the offset that was added to the original dependent variable. Given the magnitudes of the 90^{th} quantiles, the effect is trivial.

References

Hayashi, F. (2000). Econometrics. Princeton University Press.

Wooldridge, J. M. (2001). Econometric Analysis of Cross Section and Panel Data (1^{st} ed.). The MIT Press.

APPENDIX D

Montana Independent Telecommunications Carriers, Advanced Services/Facilities Map